

## SHORTER NOTES

***Botrychium simplex* E. Hitchcock: a New Moonwort for the Indian Himalayan Mountains.**—The genus *Botrychium* Sw., has a nearly cosmopolitan distribution in the subtropical, temperate, boreal and polar regions of the world (Copeland, *Genera Filicum*. Cronica Botanica Co. Waltham Mass. USA. 1947; Wagner Jr., *Ophioglossaceae*. In: K. Kubitzki, ed. *The Families and Genera of Vascular Plants*. I. Pteridophytes and Gymnosperms pp. 193–197. Vol. eds.: K. U. Kramer and P. S. Green, Springer-Verlag. 1990). The genus is represented by 50–60 species (Wagner and Wagner, *Ophioglossaceae* C. Agardh: Adder's-tongue family. pp. 85–106. In: *Flora of North America* Editorial Committee, eds. *Flora of North America, north of Mexico, Part 2: Pteridophytes and gymnosperms*. Oxford University Press, New York. 1993) of which 19 occur in Asia (Sahashi, Preliminary review on Asian Botrychiaceae. pp. 54–75. In: X. -C. Zhang and K. -H. Shing, eds. *Ching Memorial Volume*. China Forestry Publishing House, Beijing. 1999). In India, the genus is well studied at national and regional levels (Beddome, *Handbook to the Ferns of British India: Ceylon and the Malay Peninsula*. pp. 469, Thacker, Spink, and Co., Calcutta, India. 1883; Clarke, *Trans. Linn. Soc. Ser. 2: Botany, Vol. 1*. 587. 1880; Panigrahi and Dixit, *Proc. Nat. Inst. Sci. India* 35 B (3): 230–266. 1969; Goswami, *Bionature*. 7:47–89. 1987; Bir and Bhusri, *Indian Fern J.* 2: 39–56. 1985; Khullar, *An illustrated fern flora of West Himalaya Vol. I*. pp. 1–15. International Book Distributors, Dehradun, India. 1994) and is included in several checklists and survey reports (Iwatsuki, *Pteridophyta*. In: *Flora of the eastern Himalaya*. pp. 166–205. In: Ohashi, ed, 3rd report. *Bull. Univ. Mus. Univ. Tokyo*. 1975; Dixit, *A Census of the Indian Pteridophytes*. pp 21–22. Botanical Survey of India. Howrah, India. 1984). Following Panigrahi and Dixit (1969), recently Fraser-Jenkins (*Taxonomic revision of three hundred Indian subcontinental Pteridophytes*. pp 21–22; 525–526. Bishen Singh Mahendra Pal Singh, Dehradun, India. 2008) recognized six species of *Botrychium* from India; these are: *Botrychium daucifolium* Wall. ex Hook. et Grev., *Botrychium lanuginosum* Wall. ex Hook. et Grev., *Botrychium lunaria* (L.) Sw., *Botrychium multifidum*(Gmel.) Rupr., *Botrychium ternatum* (Thunb.) Sw. and *Botrychium virginianum*(L.) Sw. However, he did not accept various subspecies or varieties others described from India or the Himalayas. The present author follows this treatment, because most of these taxa from the Indian region are based on abnormal specimens or on minor geographical or climatic variations. Moreover, these variations are neither stable nor found as populations. Most of the Indian *Botrychium* are distributed throughout the hilly regions, but *Botrychium lunaria*, the common moonwort, is restricted to the alpine regions of the Himalayas (Beddome, 1883; Clarke, 1880; Hope, *J. Bombay Nat. His. Soc.* 15: 108. 1903).

*Botrychium simplex* E. Hitchcock, the least moonwort, was described by Hitchcock in 1823 (*American Journal of Science and Arts*. 6:103. 1823). In



1821, plants initially considered to be *B. lunaria* had been discovered in Massachusetts, USA; after careful study, Hitchcock (1823) determined they were distinct enough from *B. lunaria* to warrant the status of species. Several varieties have been recognized by Eaton (Fern Bulletin 7:7–8. 1899), Clute (Our ferns in their haunts: a guide to all the native species. pp. 51–63. Frederick A. Stokes Co. New York. 1901), Clausen (Mem. Torrey Bot. Club 19:1–177. 1938) and Wherry (Amer. Fern J. 27: 58. 1937). Wagner and Wagner (1993) advocated that *B. simplex* exhibits phenotypic responses to different habitats and climates, hence almost all infraspecific taxa are environmental forms and juvenile stages of *B. simplex*; however, they accepted the alternate concept of “eastern” and “western” forms (Anderson, *Botrychium simplex* E. Hitchcock (little grape fern): a technical conservation assessment. 2006. USDA Forest Service, Rocky Mountain Region. [Online] <http://www.fs.fed.us/r2/projects/scp/assessments/botrychiumsimpler.pdf>, accessed on 3rd December 2010). Farrar (*Botrychium simplex*. In: Moonwort (*Botrychium*) Systematics. Iowa State University, Department of Ecology, Evolution and Organismal Biology, Ada Hayden Herbarium. 2005. [online] <http://www.public.iastate.edu/~herbarium/botrychium/B-simpler.pdf>, accessed on 7 August 2011) recognizes these as *B. simplex* var. *simpler* and *B. simplex* var. *compositum* (Lasch) Milde. Recent genetic analysis suggests that there is genetic variation within *B. simplex* (Hauk, Am. Fern J. 85:375–394.1995; Farrar, Population genetics of moonwort *Botrychium*. In: N. Berlin, P. Miller, J. Borovansky, U. S. Seal, and O. Byers (Eds.), Population and habitat viability assessment for the goblin fern (*Botrychium mormo*), 109–113, Final Report. The Conservation Breeding Specialist Group, Apple Valley, Minnesota, USA. 1998; Farrar, Systematics of western moonworts *Botrychium* subgenus *Botrychium*. In: Popovich, S. J. (ed.). United States Forest Service moonwort workshop. Arapaho-Roosevelt National Forests and Pawnee National Grassland, Fort Collins, Colorado, 2005).

*Botrychium simplex* is predominantly an American species, growing in western and eastern temperate to boreal North America and southern Greenland (Wagner and Wagner, 1993). It is rare in Iceland and according to Øllgaard (Scandinavian ferns: a natural history of the ferns, clubmosses, quillworts, and horsetails of Denmark, Norway, and Sweden. Rhodos, Copenhagen, Denmark. 1993) is distributed across Europe, where it is rare in the west, but is more abundant in eastern Europe and adjacent western Russia. Clausen (1938) cites a report of it by Nakai from Yizo, Japan. In his treatment of *Botrychium* in the Flora of Japan, Kato (Ophioglossaceae. In K. Iwatsuki, T. Yamazaki, D.E. Boufford and H. Ohba eds.: Flora of Japan. Vol. I. Pteridophyta and Gymnospermae. pp. 22–29. Kodansha, Tokyo. 1995.) placed plants previously identified *B. simplex* var. *tenebrosum* under *B. lunaria*. *Botrychium simplex* is not mentioned by Zou and Wagner (Am. Fern J. 78:122–135. 1988) as occurring in China. In his review of Asian Botrychiaceae, Sahashi (Ching Mem. Vol. 1999) did not mention the occurrence of *B. simplex* from Asia and he again advocated his previous report (Sahashi Japan. J. Jap. Bot. 58: 109–112.1983) about the merging of previously indentified *B. simplex* (Faurie’s specimen no. 5473 from Mt. Sharidake, Hokkaido in P) in to *B. lunaria*.



Furthermore, Kato (personal comm. 16-Aug. 2011) mentioned that there is no recent report of this species from Japan, and previous records of *B. simplex* from Japan (cited by Clausen 1938; and Nishida in *Acta Phytotax. Geobot.* 18: 39–43. 1959) are for dwarfed *B. lunaria*. In their treatment of *B. simplex* in the *Flora of North America*, Wagner and Wagner (1993) do not mention Asian plants. However, in Asia, *B. simplex* may have been overlooked by pteridologists because of its similarity to *B. lunaria*, and because the many cryptic species of *Botrychium* are extraordinarily difficult to distinguish from each other due to their morphological similarity (Hauk, *Am. Fern J.* 85: 375–394.1995).

Recently, Fraser-Jenkins (2008) found three herbarium sheets (one at PE and two at BM) of *B. simplex* within the bundles of *B. lunaria* collected by F. Kingdon-Ward from Tibet (Xizang) province of China. Because of the close proximity of the *B. simplex* Tibetan locality to the Indian frontiers, as well as climatic similarities between the regions, Fraser-Jenkins postulated that the *B. simplex* should also be present in India. He also noticed that Sino-Himalayan and American-European plants of *B. simplex* were morphologically distinct and the latter was given a new rank of subspecies as *Botrychium simplex* subsp. *kannenbergii* (Klinsm.) Fraser-Jenk. However, for the Asian plants he retained the name *Botrychium simplex* subsp. *simplex* (Syn. *Botrychium tenebrosum* A. A. Eaton, *Botrychium simplex* var. *tenebrosum* (A. A. Eaton) R. T. Clausen). Clausen (1938) placed *B. kannenbergii* in synonymy with *B. simplex* var. *typicum* Clausen, which is synonymous with *B. simplex* var. *simplex*. So, based on the text here, Sino-Himalayan and American-European plants are the same i.e., *B. simplex* var. *simplex*. Similarly, according to Clausen (1938), *B. tenebrosum* or *B. simplex* var. *tenebrosum* and *B. simplex* var. *simplex* are not synonymous, hence both are different taxa. But according to Fraser Jenkins (2008), the variations in *Botrychium simplex* var. *tenebrosum* (taller plants with fertile branched attached further up) are under the normal morphological range of *Botrychium simplex* subsp. *simplex* and are due to environmental factors and he treated them as synonyms.

While on a fern collection trip to high altitudes of North Sikkim, India, the author found some interesting *Botrychium* (*B. S. Kholia* no. 35481, 9 September 2010, BSHC) from ca. 4–5 km West of Thangu. After crossing the Thangu river via a foot bridge, and after ascending a few meters, the right foot path goes to Chopta valley and the left ascends to another beautiful valley and a Shiv temple. The plants were found growing near the mountain summit of these two valleys, on a SE facing slope hardly 5–10 m below the mountain top, ca. 4320 m elev., ca. 27° 53' 41" N, 88° 31' 23 E". These plants are small (6–13 cm tall) with somewhat deltate, shortly stalked trophophores, which are attenuate at the base and have only one or two pairs of pinnae. Pinnae are asymmetrical, spathulate or obovate deltate, cuneate and adnate to the winged rachis. The sporophore is also very short with large sessile globose sporangia arising from the rachis except the lowest pair which are short stalked and often slightly branched and bear 3–5 sporangia. These plants are markedly different from *B. lunaria*. In *B. lunaria* the trophophore is lanceolate to narrowly ovate,



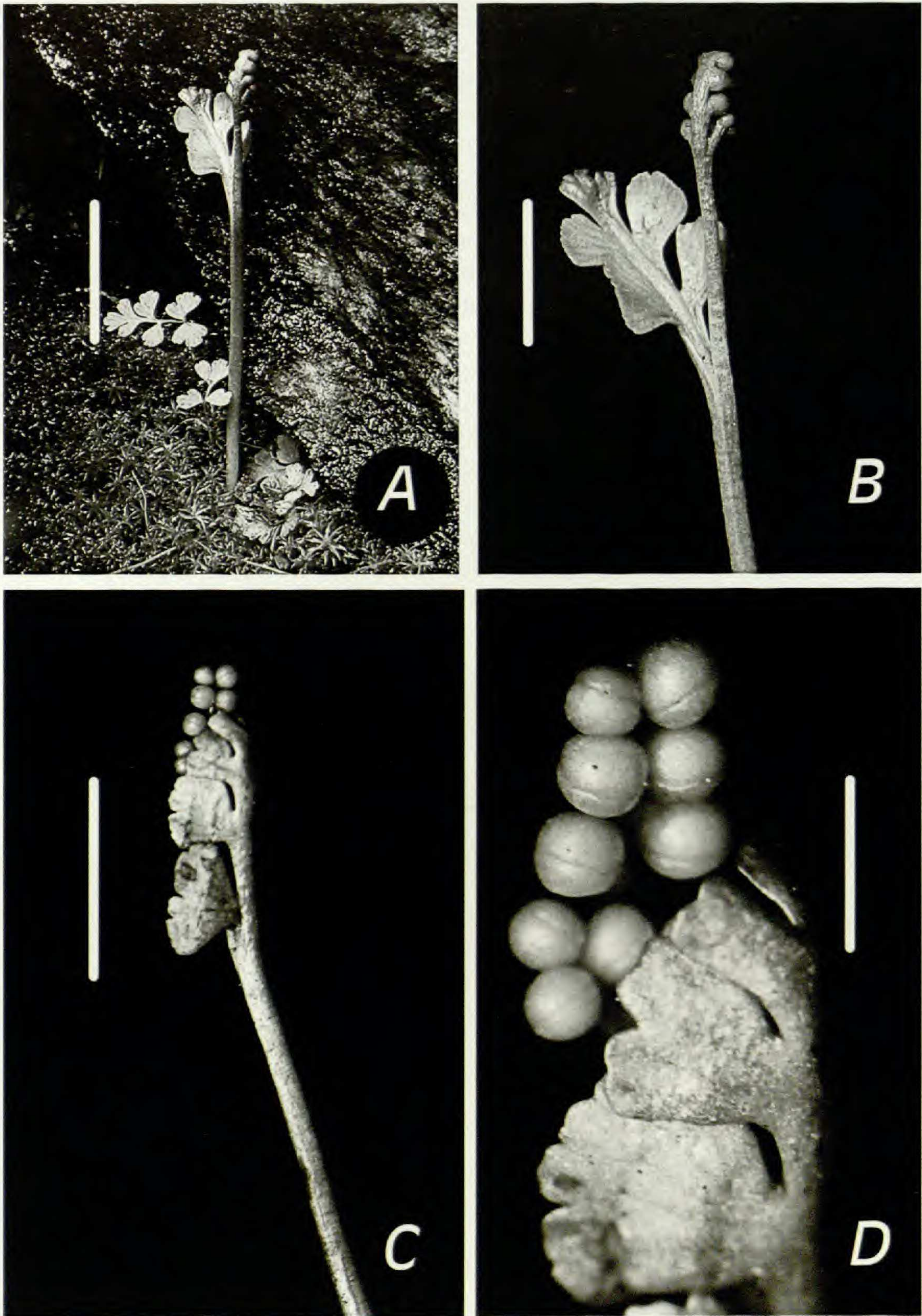


FIG. 1. *Botrychium simplex* A: Habit; B-D: Close up of trophophore and sporangiophores. (Scale bar: A = 2.5 cm, B = 1.5 cm, C = 2 cm, D = 0.5 cm).



generally long stalked, once pinnate with ca. 5–10 pairs of pinnae which are broadly fan-shaped or lunate in shape and stalkless to shortly stalked. The sporophores of *B. lunaria* are pinnate (sometimes the lower pairs are bipinnate).

During the International Symposium on Pteridophytes (November, 2010, Palampur Himachal Pradesh, India) photos of this *Botrychium* (Fig. 1 A-D) were shown to C. R. Fraser-Jenkins, who identified them as *B. simplex*. These photos were also sent to Prof. Donald Farrar, who agreed with Fraser-Jenkins' determination. Thus, this is the first record of *B. simplex* in the Indian Himalayan Mountains. This find expands the range of *B. simplex*. At present, in India, this species is known only from the locality mentioned above. More plants are likely to be found after thorough surveys in similar habitats of Indian and Sino Himalayan regions.

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